TECHICAL NOTE
PLANT MATERIALS
23

FORAGE QUALITY ANALYSIS OF SEVERAL PULLMAN PLANT MATERIALS CENTER RELEASES.

by

Mark Stannard and Clarence Kelley
Spokane, Washington

October 1993

Forage quantity and quality are two very important factors which concern livestock producers. Forage quantity is commonly estimated by producers every year and livestock feed requirements are based on these estimates. Forage quality on the other hand is not as easily determined. "Ballpark estimates" are commonly used to estimate forage quality of pasture and range plants. Most producers would agree that "ballpark estimates" are inadequate and better estimates are needed.

Several plant releases made by the Pullman PMC were analyzed for feed quality by the *International Feedstuffs Institute* as part of a nation-wide project. Forage samples were taken at various stages of plant development from plants growing at the Pullman PMC in 1973, 1976, and 1980. Figure 1 and Table 1 show the various components of forage dry matter. Over fifteen separate feed analyses were completed and a printout was provided to the center. An abridged report of those results is shown in Table 2.

Forage quality varied considerably between growth stage and species. Quality of the grasses tested is best in the vegetative stages and decreases considerably with reproductive growth. Regrowth of pasture grasses such as 'Latar' orchardgrass and 'Alta' tall fescue exhibited higher quality than samples tested at reproductive stages.

Crude protein varied considerably with the stage of growth but varied less so between species sampled at the same stage of growth. For example, crude protein for 'Secar' bluebunch wheatgrass varied from 23.4 to 7.0% for the early vegetative stage and dough stage, respectively. Crude protein measured for samples collected in the late bloom stage ranged from 6.4 to 10.9% for 'Alkar' tall wheatgrass and 'Latar' orchardgrass, respectively. Crude protein may also vary between cultivars of a given species. However, the value of breeding cultivars for protein content is of doubtful value since protein content can be manipulated by stage of growth at harvest, (Howarth and Goplen, 1983).

'Cascade' birdsfoot trefoil exhibited excellent forage quality at the mid bloom stage for most parameters with the exception of the lignin content, 12.4%. Alfalfa sampled at the same growth stage in comparison showed an average lignin content of 5.5% in the 1971 Atlas of Nutritional Data on United States and Canadian Feeds. Lignin is an important indigestible component of forage and is negatively associated with forage quality. Lignin content generally increases with plant maturation.

Table 1. Classification of forage fractions using the Van Soest method.

		-----Nutritional Availability------	
Fraction	Components	Ruminant	Non-ruminant
Cell	Sugars, Starch, pectin	Complete	Complete
Contents	Soluble carbohydrates	Complete	Complete
	Protein. Non-protein N	High	High
	Lipids (fats)	High	High
	Other solubles	High	High
Cell Wall	Hemicellulose	Partial	Low
(NDF)	Cellulose	Partial	Low
	Heat Damaged Protein	Indigestible	Indigestible
	Lignin	Indigestible	Indigestible
	Silica	Indigestible	Indigestible

Source: Van Soest (1967)

In a similar study, the Pullman PMC provided forage samples of several accessions of Siberian wheatgrass and 'Nordan' crested wheatgrass to the WSU Forage Lab for analysis in 1992. Samples were collected at Central Ferry, Washington and taken at: 1) early vegetative growth, 2) late vegetative growth to boot, and 3) seed filling stages. Crude protein, Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) of 'Nordan' and 'P-27' Siberian wheatgrass are shown in Table 3. Clearly, forage quality diminishes as the two cultivars mature.

While the results of the analyses are good estimates, it is important to realize that these analyses results are for specific cultivars which were sampled at the PMC and Central Ferry at specific dates. Climatic conditions, soil conditions, and cultivar type all effect feed quality and quantity.

References

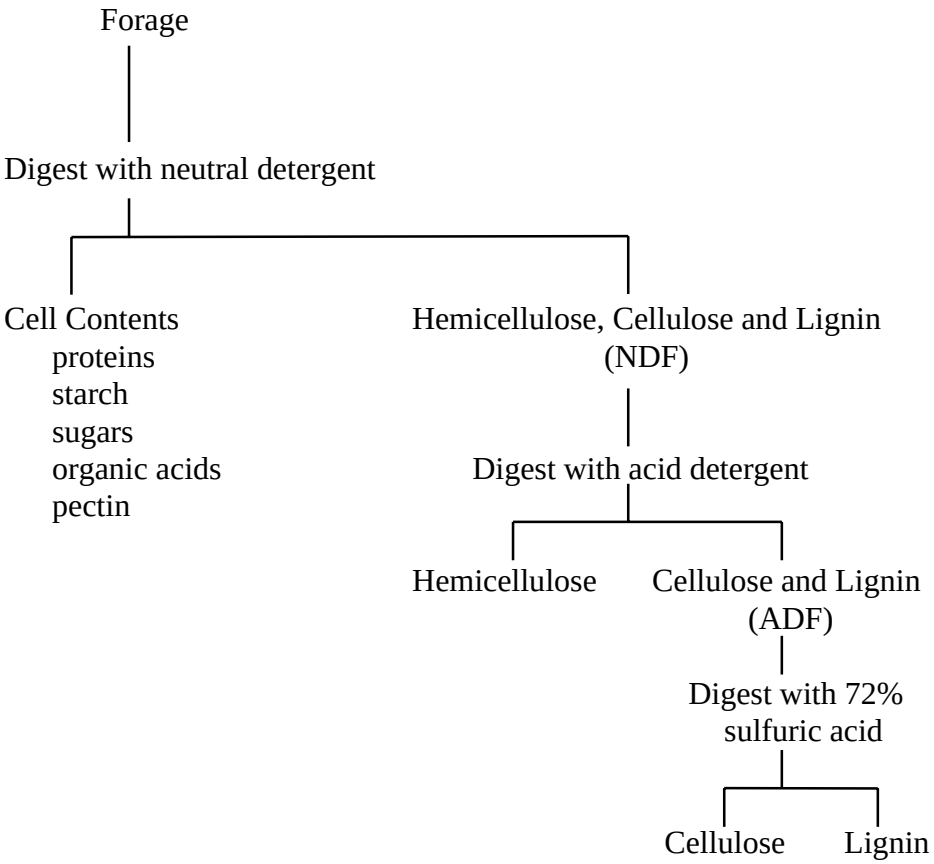
The Atlas of Nutritional Data on United States and Canadian Feeds (1971) published by the National Academy of Sciences.

Howarth, R.E. and B.P. Goplen. 1983. Improvement of forage quality through production management and plant breeding. Can. J. Plant Sci. 63:895-902.

Pioneer Forage Manual - A Nutritional Guide. 1990. Pioneer Hi-Bred International, Inc.

Van Soest, P.J. 1967. Development of a comprehensive system of feed analyses and its application to forages. J. Animal Sci. 26:119-128.

Figure 1. The detergent (Van Soest) procedure to partition forages.



Source: Pioneer Forage Manual - A Nutritional Guide. 1990.
Pioneer Hi-Bred International, Inc.

Table 2. SHORT SYNOPSIS OF THE FORAGE QUALITY DATA PRODUCED BY DR. FONNESBECK OF THE INTERNATIONAL FEEDSTUFFS INSTITUTE.

CULTIVAR STAGE OF GROWTH DATE SAMPLED	DRY MATTER	ASH[1]	CRUDE PROTEIN[2]	NDF[3]	HEMICELL-ULOSE[4]	ACID INSOL. ASH[5]	LIGNIN[6]	CELLULOSE[7]	Ca	Mg	P
	(%)										
LATAR											
Orchardgrass											
late veg 5-10-76	---	---	16.9	58.1	19.2	1.7	5.1	29.4	--	--	--
mid bloom 6-14-73	---	6.9	7.0	---	---	---	---	---	.98	.33	.12
late bloom 7-7-80	33.3	9.9	10.9	70.7	20.5	3.2	7.6	36.4	.60	.28	.12
regrowth 8-2-73	---	---	13.1	60.1	14.7	1.5	8.7	32.4	--	--	--
SECAR											
Bluebunch Wheatgrass											
early veg 3-10-80	36.0	16.4	23.4	53.9	15.6	6.9	3.4	25.3	1.04	.42	.29
late veg 5-26-80	30.5	9.2	14.7	72.1	21.2	3.3	7.0	37.7	.56	.19	.22
mid bloom 7-7-80	49.8	8.0	9.1	71.5	15.3	3.5	9.6	40.2	.47	.13	.16
late bloom 7-10-80	41.8	9.0	10.5	73.5	19.0	4.9	8.9	37.8	.51	.10	.18
dough 7-18-80	54.2	7.0	7.0	71.7	17.8	4.0	10.1	36.8	.39	.10	.14
WHITMAR											
Beardless Wheatgrass											
late veg 4-26-80	33.1	10.3	12.9	72.7	18.8	3.4	6.2	41.4	.41	.17	.20
mid bloom 7-7-80	50.7	9.1	10.3	71.7	16.9	5.1	8.9	37.9	.49	.15	.15
late bloom 7-9-80	45.8	10.9	10.4	74.4	20.0	5.6	9.9	36.0	.45	.14	.17
dough 7-17-80	54.0	8.4	7.4	73.4	19.4	4.5	10.6	37.3	.36	.11	.13

SHERMAN											
Big Bluegrass											
late veg	34.5	7.9	11.8	74.0	20.1	3.1	7.6	40.2	.42	.18	.20
5-26-80											
mid bloom	32.0	10.7	9.8	75.0	17.5	4.5	8.7	41.3	.49	.20	.22
6-9-80											
late bloom	45.9	11.0	9.1	75.6	19.7	5.5	9.1	39.3	.46	.17	.20
6-23-80											
dough	59.3	9.6	9.6	76.8	19.9	4.5	9.7	39.7	1.43	.13	.24
7-7-80											
ALKAR											
Tall Wheatgrass											
late bloom	48.1	7.8	6.4	78.1	19.0	4.0	8.8	43.3	.40	.18	.11
8-3-80											
CASCADE											
Birdsfoot Trefoil											
mid bloom	16.7	15.7	18.8	48.7	7.2	2.0	12.4	24.5	1.69	.80	.26
6-20-80											
ALTA*											
Tall Fescue											
early bloom	---	---	11.8	---	18.4	0.9	5.6	35.8	--	--	--
5-14-73											
full bloom	---	6.9	7.2	64.0	15.2	1.1	4.6	40.2	.81	.35	.11
6-14-80											
8-28-73 + 10-8-73	---	---	16.3	51.4	15.6	1.9	5.3	25.9	--	--	--

*** Not a Pullman PMC release**

---

1 **Ash** inversely correlates with forage quality
2 **Crude protein** correlates with forage quality
3 **NDF** (Neutral Detergent Fiber) inversely correlates with forage quality
NDF = cellulose + hemicellulose + lignin + ash +/- error
4 **Hemicellulose** inversely correlates with forage quality
Hemicellulose partially digestible depending on type livestock, lignin content,etc.
5 **Acid Insoluble Ash** inversely correlates with forage quality
6 **Lignin** inversely correlates with forage quality
7 **Cellulose** inversely correlates with forage quality

Table 3. Forage quality of 'Nordan' and 'P-27' sampled at three stages of growth in 1992.

CULTIVAR STAGE OF GROWTH DATE	CRUDE PROTEIN	ACID DETERGENT FIBER (ADF)	ACID DETERGENT LIGNIN (ADL)
	----------(percent)----------		
NORDAN			
Crested Wheatgrass			
early vegetative 3-24-92	24.2	26.9	6.0
late vegetative 5-1-92	13.2	32.6	4.6
seed filling 6-8-92	6.5	37.0	12.4
P-27			
Siberian Wheatgrass			
early vegetative 3-24-92	18.2	32.2	7.6
late vegetative 5-1-92	16.9	29.4	4.9
seed filling 6-8-92	10.9	36.4	9.5